

**COGNITIVE STYLES AND ACADEMIC ACHIEVEMENT AMONG  
SECONDARY SCHOOL LEARNERS IN KENYA**

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DECLARATION

This research project is my original work and has not been presented to any other University for any award.

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This research project has been presented for examination with my approval as the University of Nairobi supervisor.

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## **DEDICATION**

I would like to express my sincere thanks and gratitude to the Almighty God who has given me good health and the ability to undertake this programme at the University of Nairobi.

I dedicate this work to my beloved husband Kennedy Musya and children: Dr. Jeffrey, Stella, Dorcas, Elijah and Titus, for the support they gave me and also for their patience with regard to my absence during the time of my studies. To all family members I thank them for their financial and moral support.

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## ABSTRACT

This study was based on *cognitive styles and academic achievement among secondary school learners in Kenya*. The purpose of the study was to find out the extent to which students' cognitive styles influence their academic performance in chemistry.

The study applied a quantitative research approach, descriptive in nature.

The following objectives were addressed:

- To determine the cognitive styles of students
- To determine the differences in students' cognitive styles among boys and girls
- To find out the relationship between the students' cognitive styles and their academic achievement in chemistry

To address these objectives, 200 form three students taking chemistry responded to questionnaires. The questionnaires contained three sections: personal information of the students, performance in chemistry and field independence/ dependence questionnaire. Sampling was done using stratified and systematic random sampling. Two processes of data arose: One process on performance in chemistry from section B and the other one from section C on students' cognitive styles. The data collected was subjected to data analysis using statistical package for social sciences (SPSS). The analysis involved computation of the means of scores in chemistry tests and the standard deviations for the scores. The correlation coefficients were computed using the Pearson Product Moment Correlational Analysis. The results show that both Field independent and Field dependent cognitive styles are evident among the secondary school students. The results also show that more male students were found to be field dependent while more female students were field independent and that field independent individuals scored higher

than field dependent individuals. According to the research results the study show that cognitive styles could have significant influence on students' academic achievement in chemistry and that there could be a difference in the type of cognitive style between boys and girls. Depending on the cognitive style one has, this could have an influence on academic achievement in a particular discipline.

However, there is need for further research with a large sample and various types of learners as well as various disciplines to make a conclusive conclusion on cognitive styles and academic performance.

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## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background of the study**

Different researchers emphasized different dimension of individual differences which correlate with higher academic achievement. This holds out some hope for positive action for educational practice (Babalola, 1989; Stephen, 2002). Of these dimension, cognitive styles and students' attitude are major ones. This study is on cognitive styles and academic achievement among secondary school learners in Kenya. Cognitive style is the control process or style which is self generated, transient, situationally determined conscious activity that a learner uses to organize and to regulate, receive and transmit information. Studies on cognitive style have shown that individuals do not approach scientific tasks in the same manner (Babalola, 1989; Onwu & Asuzu, 1989). There are different cognitive strategies for processing information which in turn influence students' academic achievement. Thornel (1994) therefore, strongly suggests the consideration of cognitive styles and students academic achievement as important criteria in the development and implementation of both curricula and instructional performance. Cognitive styles have emerged as a new dimension within individual differences through cognitive psychology studies in the field of information processing. It has a particular importance as it determines the way information processing when solving problems or making decisions or interpretation of stimuli and response. Every Individual has his/ her own style in the organization of perception and memory. Therefore, psychologists are interested in studying cognitive style as an important dimension of the individual differences. Cognitive style is the basis of discrimination between individuals during their interaction with the elements of the situation,

and also is an important approach to understanding a personal way of thinking (Sternberg & Willams, 2002).

The study of cognitive style also helps in identification of the potential of the individual preparations, in order to be considered when designing educational programs, academic and vocational guidance (Ates & Catalogu, 2007). Etoum (2004) indicates that one of the most important guidelines that prescribe the form of learning and how to deal with the elements of the position of learning is cognitive style, and there is a relationship between cognitive style and academic achievement. Each student has their own way or style of learning. There are students who are more interested in analytical subjects such as mathematics and science, while others are interested in social and language. About socializing, some students like to be alone and others like groups. On issues about managing the information of the subject matter, there are students who receive the information for what it is but there are also students who can restructure information.

The task of the teacher is to help students learn according to the cognitive style of the students. There are many dimensions of cognitive styles that distinguish individuals in their dealings with the various situations to which they are exposed. The most important of these dimensions is field-dependent and field-independent cognitive style. This dimension refers to relatively stable individual differences in the interaction with the elements of the situation. Individuals with field-independent cognitive style have ability to deal with the subject perceived separately from the surrounding elements, and consider those elements which appear as a background figure as a whole. Individuals with field-dependent cognitive style cannot deal with the subject perceived separately from the surrounding elements (Ates & Catalogu, 2007). Witkin et al. (1977) suggested that individuals with field-independent cognitive style have psychological

and social characteristics. The most important of them include high-ability of analysis and self-leadership. Field-independent individuals resolve a problem in absence of clear data and are not affected by criticism. They enjoy dealing with abstract ideas and theories, relatively tend to be concentrated on self, enjoying the isolation and they have high ambition. Field-independent individuals indicate clear awareness of their needs, feelings and goals, tend to confrontation and show indifference to the opinion of others. They prefer technological disciplines, tend to deal with complex situations, and prefer independent activities. Individuals with field-dependent cognitive style are friendly, tend to work with others and do not enjoy dealing with abstract ideas and theories. They are usually influenced by others, less centered around the self and respond largely to outside stimuli. Field-dependent individuals need detailed information to solve problems, they are adept at solving problems related to social interaction and are affected by criticism. They prefer occupations which are based on interaction with others and do not prefer tasks that require analysis.

The major concern of this study therefore is to find out the cognitive styles among the form three students, how the cognitive style of an individual learner affects his / her performance in chemistry and whether there exists any significant relationship between cognitive style and gender.

## **1.2 Statement of the problem**

Over the years, studies have been done to establish the relationship between cognitive styles and academic achievement in different subjects. A study by Norlia Abd Aziz, Subahan Meerah et.al. (2006), showed that there is a significant relationship between students' cognitive styles and internal motivation with their academic achievement. Another study showed that

students would score low grades if they fail to adapt to the way of teaching and learning in the universities (Baharin Abu, 2000).

Despite the effort to address the complexities of students in relation to their cognitive styles and academic achievement, many students continue to score low grades in different academic subjects. There is need to determine how they learn or their cognitive styles and how this influences their performance.

### **1.3 Purpose of the study**

The purpose of the study is to find out the extent to which students' cognitive styles influence their academic performance in chemistry.

### **1.4 Objectives of the study**

- 1) To determine the cognitive styles of students
- 2) To determine the differences in students' cognitive styles among boys and girls
- 3) To find out the relationship between the students' cognitive styles and their academic achievement in chemistry

### **1.5 Research questions**

- i. What is the cognitive style (field-dependent & field-independent) among form three students?
- ii. Are there differences in the (field-dependent & field-independent) cognitive style among boys and girls in secondary schools?
- iii. Is there a relationship between the cognitive styles and academic achievement in chemistry?



- iv. Are there specific cognitive styles attributed to girls and boys in relation to academic achievement?

### **1.6 Significance of the study**

The consideration of cognitive styles and student academic achievement are important criteria in the development and implementation of both curricula and instructional performance. Learners can enhance their learning power by being aware of their cognitive styles. By working on those cognitive style areas, learners can be provided by avenues to foster their intellectual growth. Similarly, teachers can identify strong style patterns in their classes and utilize relevant approaches to accommodate individual cognitive style preferences. The information about cognitive styles will also be useful for curriculum designers and classroom teachers in order to utilize relevant approaches to enhance meaningful learning. The knowledge of students' cognitive style would be very useful in both academic and career counseling.

### **1.7 Justification of the study**

There are quite a number of existing researches on cognitive styles and learning. This study will add value to the existing knowledge of field dependence/field independence as it seeks to establish the existing differences in cognitive style among boys and girls in secondary schools in Kenya, the extent of the presence of the cognitive styles in a single classroom and also how the two cognitive styles affect the achievement of learners in chemistry.

Various studies have been done on field dependent/field independent cognitive style. This study therefore will come up with findings which will help to determine whether the field dependent/field independent cognitive styles have the same impact on academic achievement in

chemistry regardless of the geographical region. It is hoped that the knowledge of students' cognitive styles would be very useful in both academic and career counseling.

## **1.8 Terminologies**

**Cognition-** A general term used to refer to the higher mental processes. *Cognition* is the process, by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used (Neisser, 1967). In science and mathematics, cognition is the mental process that includes the attention of working memory, comprehending and producing language, calculating, reasoning, problem solving, and decision making. In cognitive psychology and cognitive engineering, cognition is typically assumed to be information processing in a participant's or operator's mind or brain (Blomberg 2011).

**Cognitive psychology** is the study of mental processes such as "attention, language use, memory, perception, problem solving, creativity, and thinking." *"American Psychological Association (2013)*. Much of the work derived from cognitive psychology has been integrated into various other modern disciplines of psychological study, including educational psychology, social psychology, personality psychology, abnormal psychology, developmental psychology, and economics.

**Cognitive style-** The control process or style which is self generated, transient, situationally determined conscious activity that a learner uses to organize and to regulate, receive and transmit information and ultimate behaviour. *Cognitive style* or "thinking style" is a term used in cognitive psychology to describe the way individuals think, perceive and remember information.

**Cognitive Development** – Cognitive development refers to the construction of a thought process that includes problem solving, remembering and the ability to make decisions from childhood upto the adulthood stage. This ability to learn, reason and analyze the fact that a process begins from infancy and progresses as the individual grows. It involves activities that are conscious and intellectual like thinking and remembering. (Schacter Daniel L. 2009)

**Academic achievement**- The acquired knowledge and skills as a result of interaction between the learner and the learning environment.

**Learning**-Act of acquiring new or modifying and reinforcing existing knowledge, behaviours, skills, values or preferences and may involve synthesizing. Learning can also be defined as the activity of gaining knowledge or skill by studying, practicing, being taught or experiencing something.

**Learning power**-The ability of acquiring new or modifying and reinforcing existing knowledge, skills, values and preferences.

**Scientific tasks**-Activities involving acquisition of scientific facts, theories values and practices then utilizing them in reasoning, synthesis and problem solving.

**Thinking**- Refers to the act of producing thoughts or the process of producing thoughts. Thinking can also be viewed as the action of using one's mind to produce ideas, decisions; memories e.t.c. Critical thinking involves providing a forum and resources about Socratic questioning, higher order thinking and critical analysis. Critical analysis is clear, rational thinking involving critique.

**Remembering** - The retrieval of events or information from the past.

- To recall to the mind by an act or effort of memory.

**Field dependence-** The state of being easily influenced by the surrounding environment. Field dependent individuals rely more on external frames of reference (that is, they depend to a greater extent on their superior social skills to solve a problem), implying that Field dependent individuals have a greater ability to perceive globally. Field-dependent individuals take a passive approach, are less discriminating and tend to the most salient cues regardless of their relevance.

**Field independence-**The state of a learner to rely more on internal frames of reference (that is, they are less dominated by the more obvious or salient cues that a problem presents and are thus able to perceive analytically). Field independent individuals are not usually affected by the surrounding environment. Field-independent individuals tend to adopt an analytical approach to problem solving, sample more cues inherent in the field and are able to extract the relevant cues necessary for the completion of a task.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

Cognitive style has been used for more than 25 years by researchers to investigate how individuals process information and make choices in learning. Cognitive style can be viewed as an individual preferred and habitual approach to organizing and representing information (Chen and Macreadie, 2002). Cognitive styles, like reasoning ability, has been extensively studied over many disciplines (Davis, 1991), and recent studies have looked at the role it plays in individual's choice of vocation (Hicks et al- 2007).

Studies on cognitive style have shown that individuals do not approach scientific tasks in the same manner (Babalola, 1989; Onwu & Asuzu, 1989). There are different cognitive strategies for processing information which in turn influence students' academic achievement. Thornel (1994) therefore, strongly suggests the consideration of cognitive styles and students academic achievement as an important criterion in the development and implementation of both curricula and instructional performance. There are various theoretical classifications of cognitive style, but the one which has probably garnered the most attention in the literature is Witkin's Field Dependence/Field Independence (FD/FI) model (Witkin et al., 1977). In this classification, it is argued that FI individuals rely more on internal frames of reference (that is, they are less dominated by the more obvious or salient cues that a problem presents and are thus able to perceive analytically), while FD individuals rely more on external frames of reference (that is, they depend to a greater extent on their superior social skills to solve a problem), implying that

FDs have a greater ability to perceive globally. Field-independent individuals tend to adopt an analytical approach to problem solving, sample more cues inherent in the field and are able to extract the relevant cues necessary for the completion of a task. Conversely, field-dependent individuals take a passive approach, are less discriminating and tend to the most salient cues regardless of their relevance.

In experiments that attempt to flesh out differences in performance between FI and FD individuals, it has been found that FI learners, when faced with a limited amount of unambiguous task relevant information, will frequently outperform their FD learner peers (Rollock, 1992). In fact, Davis and Cochran (1989) indicate that research generally shows that field independent students, reflect higher levels of achievement than field dependent students do.

Muhammad (2001) pointed that students with field- independent cognitive style have higher academic achievement than students with field- dependent cognitive style.

O'Brien et al, (2001) summarizes the distinction between field dependent and field independent subjects succinctly:

*Field independent learners are highly analytical in perceiving and processing information, in fact, they are often referred to in literature as “analytical thinkers”. They exhibit a tendency to organize information into manageable units and appear to possess a greater capacity for the retention of information. These individuals prefer and typically use problem solving techniques, organization, analysis and structuring when engaged in learning and working situations, field dependent learners are more global and holistic in perception and information processing; in the literature they are frequently referred to as “global thinkers.” They tend to accept information as it is presented or encountered and rely to a great extent on memorization. They*

*also manifest a clear tendency to use sound frames of reference to determine their attitudes, feelings and beliefs.*

Based on 30 years of field dependence- independence research, Witkin, Moore, Goodenough and Cox (1977) felt that their cognitive style approach could be profitably applied to issues relevant to education. In reviewing this research, they recognized that it was only in the beginning stages but felt there was sufficient body of empirical evidence to suggest that field dependence had educational implications for how students learn, how teachers teach, how students and teachers interact and how students make vocational decisions.

Davis (1991) continued to summarize the results of studies investigating field dependence- field independence and academic achievement and report that they all show a consistent pattern- that the field independent students perform significantly better than field dependent students in virtually all curriculum areas.

In another study, Murphy, Casey, Day, & Young (1997) sought to determine the relationship between academic achievement and cognitive style of 63 undergraduate Canadian students in information management program. They found that field independent students performed better than field dependent subjects only on one of the technical courses. For the other three courses the two groups performed similarly. Although considerable research has been conducted on the impact of field dependence/ independence and academic achievement, the relationships between FD/FI cognitive style and learning, including the ability to learn from social environments and the impact of cognitive styles on the use of learning strategies (Jonassen, 1988; Liu & Reed, 1994), few studies have considered affective variables and cognitive styles together in teacher training programs. The construct of cognitive style has been treated as a promising variable which may explain differences observed among students'

academic achievements on various subjects and provide us a better understanding of student achievement.

Studies by Davis and Klausmeier (J. Kent Davis and Herbert J. Klausmeier, December 1970) and Ohmacht (F. W. Ohmacht 1966) on the influence of an individual's Cognitive Style on concept identification ability found that analytic subjects performed significantly better than global subjects on concept identification tasks. Grieve and Davis (Terrance D. Grieve and J. Kent Davis, 1971) and Thornell (John G. Thornell, 1974) found analytic subjects scoring significantly better than global subjects on concept attainment tests following instruction. The wholist/analytic dimension (Riding, R. J.; Cheema, I. 1991) is closely related to field independence/ field dependence dimension (Witkin, Moore, Goodenough and Cox (1977)).

Witkin and others (Herman A. Witkin and others; John Wiley & Sons, Inc. 1962) reported that analytic boys performed significantly better than global boys on a long-range recall task.

Asuzu's (1984) three cognitive styles have been well established through research findings in relation to science learning and teaching. These are: Analytic, Relational, and Inferential

Analytic style is also called field independent or descriptive cognitive style.

Onwu and Asuzu (1989) looked at Analytic styles as the tendency to associate objects or events on the basis of common characteristics, which are directly discernible (e.g. a chair and a table are similar because both have four legs). Onwu and Asuzu (1986) defined relational style as a mode to associate objects or events on the basis of features establishing a relational link between them. Onwu and Asuzu (1989) defined inferential style as the tendency to associate objects or events on the basis of super ordinate features which are not directly discernible but are inferred. It is an



imaginative tendency. For example, a car and a boat are similar because both are means of transportation.

Together, the results of these studies suggest an advantage for the analytic learner over his/her global counterpart in the elementary classroom. Morine (1992) speculated that, for instructional heuristic or partly structured tasks (new to the subjects), the learners' scientific inquiry behaviour is likely to be intimately tied to the analytic and inferential mode of categorization. Expanding further, Asuzu and Onwu (1989) stated that analytics and inferentials show curiosity and originality of ideas with scientific task than the relationals. They further maintained that relationals showed greater reluctance than the analytics and inferentials to modify hypothesis even with cueing.

Analytic subjects are spontaneously able to think scientifically and have a good ability to scan the field of data that is, make relevant observations and are able to draw internally generated models to try to explain the phenomenon. This trait they said contributes to higher achievement in science.

Those three dimensions essentially address the global- local issue of a user's preferences while performing information seeking, analyzing information and problem solving.

Several varied dimensions of the general Cognitive Style trait have been identified. One particular Cognitive Style is concerned with the manner in which individuals respond perceptually to complex configurations. The extremes of this dimension, frequently referred to as analytic /global, are characterized by ability to distinguish the components of a stimulus complex.

Evidence exists to suggest the possibility that the analytic/global dimension of Cognitive Style is an influential variable in pupil learning distinguishable from the IQ score variable. Long (R. I. Long, 1962) found an analytic Cognitive Style superior to a global style in serial learning performance. Guetzkow (H. Guetzkow, 1951) correlated performance in problem solving with Cognitive Style and found that the more analytical an individual the greater his/her success in problem solving.

### **Summary**

- Field independent individuals rely more on internal frames of reference (that is, they are less dominated by the more obvious or salient cues that a problem presents and are thus able to perceive analytically), while Field dependent individuals rely more on external frames of reference (that is, they depend to a greater extent on their superior social skills to solve a problem), implying that FDs have a greater ability to perceive globally.
- Field independent students perform significantly better than field dependent students in virtually all curriculum areas.
- Analytic subjects score significantly better than global subjects on concept attainment tests following instruction.
- Analytic boys perform better than global boys on a long-range recall task.
- Analytic Cognitive Style is superior to a global style in serial learning performance.
- The analytic/global dimension of Cognitive Style is an influential variable in pupil learning distinguishable from the IQ score variable.
- The more analytical an individual the greater his/her success in problem solving.
- Studies suggest an advantage for the analytic learner over his/her global counterpart in the elementary classroom.

- For instructional heuristic or partly structured tasks (new to the subjects), the learners' scientific inquiry behaviour is likely to be intimately tied to the analytic and inferential mode of categorization
- Analytic subjects are spontaneously able to think scientifically and have a good ability to scan the field of data that is, make relevant observations and are able to draw internally generated models to try to explain the phenomenon. This trait they said contributes to higher achievement in science.

## **2.2 Related Literature**

### **2.2.1 Cognition**

This is a general term used to refer to the higher mental processes. Cognition would generally be taken to include such mental activities as thinking and conceptualization. It deals with things like memory, mental imagery, perception and retention, reasoning and decision making and representation. Neisser's definition of "cognition" illustrates the, then, progressive concept of cognitive processes well:

The term "cognition" refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations (Neisser, U. 1967).

**Cognitive psychology** is the study of mental processes such as "attention, language use, memory, perception, problem solving, creativity, and thinking." *"American Psychological Association (2013).* Much of the work derived from cognitive psychology has been integrated

into various other modern disciplines of psychological study, including educational psychology, social psychology, personality psychology, abnormal psychology, developmental psychology, and economics.

Philosophically, ruminations of the human mind and its processes have been around since the times of the ancient Greeks. In 387 BC, Plato is known to have suggested that the brain was the seat of the mental processes. In 1637, René Descartes posited that humans are born with innate ideas, and forwarded the idea of mind-body dualism, which would come to be known as substance dualism (essentially the idea that the mind and the body are two separate substances). Malone. (2009). From that time, major debates ensued through the 19th century regarding whether human thought was solely experiential (empiricism), or included innate knowledge (nativism). Some of those involved in this debate included George Berkeley and John Locke on the side of empiricism, and Immanuel Kant on the side of nativism (Anderson, 2010).

With the philosophical debate continuing, the mid to late 18th century was a critical time in the development of psychology as a scientific discipline. Two discoveries that would later play substantial roles in cognitive psychology were Paul Broca's discovery of the area of the brain largely responsible for language production. Malone, J.C. (2009) and Carl Wernicke's discovery of an area thought to be mostly responsible for comprehension of language. (Eysenck, 1990). Both areas were subsequently formally named for their founders and disruptions of an individual's language production or comprehension due to trauma or malformation in these areas have come to commonly be known as Broca's aphasia and Wernicke's aphasia.

In the mid-20th century, three main influences arose that would inspire and shape cognitive psychology as a formal school of thought:

- With the development of new warfare technology during World War II, the need for a greater understanding of human performance came to prominence. Problems such as how to best train soldiers to use new technology and how to deal with matters of attention while under duress became areas of need for military personnel. Behaviorism provided little if any insight into these matters and it was the work of Donald Broadbent, integrating concepts from human performance research and the recently developed information theory, that forged the way in this area.(Anderson, 2010).
- Developments in computer science would lead to parallels being drawn between human thought and the computational functionality of computers, opening entirely new areas of psychological thought. Allen Newell and Herbert Simon spent years developing the concept of artificial intelligence (AI) and later worked with cognitive psychologists regarding the implications of AI. The effective result was more of a framework conceptualization of mental functions with their counterparts in computers (memory, storage, retrieval, etc.) (Anderson, 2010).
- Noam Chomsky's 1959 critique (Chomsky, 1959)of behaviorism, and empiricism more generally, initiated what would come to be known as the "cognitive revolution".
- Formal recognition of the field involved the establishment of research institutions such as (in 1964) of Mandler's "Center for Human Information Processing."

George Mandler has described the origins of cognitive psychology in 2002(Mandler, 2002).

Ulric Neisser is credited with formally having coined the term "cognitive psychology" (in terms of the current understanding of cognitive psychology) in his book *Cognitive Psychology*, published in 1967 (Neisser, 1967).Neisser's definition of "cognition" illustrates the, then, progressive concept of cognitive processes well:

The term "cognition" refers to all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations. ... Given such a sweeping definition, it is apparent that cognition is involved in everything a human being might possibly do; that every psychological phenomenon is a cognitive phenomenon. But although cognitive psychology is concerned with all human activity rather than some fraction of it, the concern is from a particular point of view. Other viewpoints are equally legitimate and necessary. Dynamic psychology, which begins with motives rather than with sensory input, is a case in point. Instead of asking how a man's actions and experiences result from what he saw, remembered, or believed, the dynamic psychologist asks how they follow from the subject's goals, needs, or instincts (Neisser, 1967).

Modern perspectives on cognitive psychology generally address cognition as a dual process theory, introduced by Jonathan Haidt in 2006, and expounded upon by Daniel Kahneman in 2011 (Kahneman, 2003). Kahneman differentiated the two styles of processing more, calling them intuition and reasoning. Intuition (or system 1), similar to associative reasoning, was determined to be fast and automatic, usually with strong emotional bonds included in the reasoning process. Kahneman said that this kind of reasoning was based on formed habits and very difficult to change or manipulate. Reasoning (or system 2) was slower and much more volatile, being subject to conscious judgments and attitudes (Kahneman, 2003).

### **2.2.2 Cognitive Styles**

Cognitive Style is the control process or style which is self generated, transient, situationally determined conscious activity that a learner uses to organize and to regulate, receive

and transmit information and ultimate behaviour. Accordingly, Glass and Riling (1993) defined cognitive style as a fairly fixed characteristic of an individual that are static and relatively in-built features of the individual. Nevertheless, Pitcher (2002) after research findings, defined cognitive style as the relatively stable strategies, preferences and attitudes that determine an individual's typical modes of perceiving, remembering and problem solving.

Wright and others (Betty A. Wright and others, 1971) describe Cognitive Style as an umbrella term covering the many ways an individual perceives, organizes, classifies and / or labels various environmental factors. Witkin and Moore (Herman A. Witkin and Carol A. Moore, April 1974) suggest that Cognitive Style, in its broadest sense, can be thought of as a typical mode of processing information.

There are various theoretical classifications of cognitive style, but the one which has probably garnered the most attention in the literature is Witkin's Field Dependence/Field Independence (FD/FI) model (Witkin et al., 1977). In this classification, it is argued that FI individuals rely more on internal frames of reference (that is, they are less dominated by the more obvious or salient cues that a problem presents and are thus able to perceive analytically), while FD individuals rely more on external frames of reference (that is, they depend to a greater extent on their superior social skills to solve a problem), implying that FDs have a greater ability to perceive globally.

On web, online resources and analyzing data, three different dimensions of a user's cognitive style have been found to affect learning in both offline and online settings, as well as affect a user's preferences in using virtual environments, web browsing and searching. They are: holist/serialist (Pask G.; Scott, B,C,E. 1972; Pask G.; 1976), field dependent/ field independence

(Witkin, Moore, Goodenough and Cox (1977) and wholist/analytic (Riding, R. J.; Cheema, I. 1991).The holist/ serialist dimension was defined by Pask (1972) with a focus on learning style. Holists tend to use a global approach to learning while serialists tend to concentrate narrowly or locally on the details of the topics being learned. (Pask G.; 1976).

This dimension can be measured using a number of different tests, for example: Free learning technique (Pask G.; Scott,B,C,E. 1972) and Study Processes Questionnaire (Ford, N. 1985).The wholist/ analytic dimension (Riding, R. J.; Cheema, I. 1991) is closely related to field independence/ field dependence dimension (Witkin, Moore, Goodenough and Cox (1977). It reflects the preferred way that a user organizes or processes information either in its entirety (holist) or in parts (analytic). Analytic users may have difficulty in seeing the big picture when solving a problem while wholist users may have difficulty decomposing a complicated problem into smaller subcomponents. The wholist/ analytic dimension can be mapped to the field dependence/ field independence dimension (Riding, R. J.; and Rayner; S.G. 2000).

With respect to the four one-dimensional models, the styles such as field independence, reflective style, divergent thinking style, and achieving approach that are located at one pole, often show positive contributions to various learning performances. Different studies suggest that thinking styles are correlated with creative process, problem solving, decision making, educational success as well as achievement, training methods and educational evaluation and also different factors including culture, age, parenting style of parents, socioeconomic status and above all gender are effective on thinking style.

### **2.2.3 Theoretical classifications of cognitive style**



The various theoretical classifications of cognitive style include: Field dependence/Field independence, Holist/ serialist, wholist/ analytic, Relational Style, Inferential style

a) Field dependence/Field independence model

There are various theoretical classifications of cognitive style, but the one which has probably garnered the most attention in the literature is Witkin's Field Dependence/Field Independence (FD/FI) model (Witkin et al., 1977). In this classification, it is argued that FI individuals rely more on internal frames of reference (that is, they are less dominated by the more obvious or salient cues that a problem presents and are thus able to perceive analytically), while FD individuals rely more on external frames of reference (that is, they depend to a greater extent on their superior social skills to solve a problem), implying that FDs have a greater ability to perceive globally.

Field dependence/ field independence (Witkin, Moore, Goodenough and Cox (1977) measures the degree "to which a learner's perception or comprehension of information is affected by the surrounding environment, or fields." Field dependents may find it hard to find the information that they are looking for, given the noise and ill-defined problems that they are working on. Field independents can find ways to recognize relevant information, or make the problems they are working more concrete. Field dependence is considered to be a global dimension while field independence focuses on the details of the fields.

Derussy and Futch (1971), Kim (1987) and Enooz (2003) pointed that students with field independent cognitive styles tend to scientific disciplines while students with field dependent cognitive style tend to humanitarian disciplines.

On web, online resources and analyzing data, three different dimensions of a user's cognitive style have been found to affect learning in both offline and online settings, as well as affect a user's preferences in using virtual environments, web browsing and searching. They are: holist/serialist (Pask G.; Scott, B,C,E. 1972; Pask G.; 1976), field dependent/ field independence (Witkin, Moore, Goodenough and Cox (1977) and wholist/analytic (Riding, R. J.; Cheema, I. 1991).The holist/ serialist dimension was defined by Pask (1972) with a focus on learning style. Holists tend to use a global approach to learning while serialists tend to concentrate narrowly or locally on the details of the topics being learned. (Pask G.; 1976).

This dimension can be measured using a number of different tests, for example: Free learning technique (Pask G.; Scott, B,C,E. 1972) and Study Processes Questionnaire (Ford, N. 1985).The wholist/ analytic dimension (Riding, R. J.; Cheema, I. 1991) is closely related to field independence/ field dependence dimension (Witkin, Moore, Goodenough and Cox (1977). It reflects the preferred way that a user organizes or processes information either in its entirety (holist) or in parts (analytic). Analytic users may have difficulty in seeing the big picture when solving a problem while wholist users may have difficulty decomposing a complicated problem into smaller subcomponents.

The wholist/ analytic dimension can be mapped to the field dependence/ field independence dimension (Riding, R. J.; and Rayner; S.G. 2000). The wholist/ analytic dimension is usually measured by an appropriate computer- based test such as Cognitive Style Analysis (CSA), ((Riding, R. J.; Cheema, I. 1991).This test compares the response time of a user while he/ she responds to a set of analytic or wholistic questions. At the end of the test, each user will be assigned to one of these three groups: wholist, analytic or intermediate. If this measure is a

number below 1.03, it is equivalent to wholist (and also field dependent) individuals; if it is greater than 1.36, it is equivalent to analytic (and also field independent) individuals.

Otherwise the individual is classified as intermediate. Witkin et al. (1977) have proposed that a contrast can be made between analytic and holistic (Gestalt) individuals. When the analytic group is faced with a situation in which decision-making is necessary, they are more able to break a problem into its components in order to choose the components which are more significant for making the right decision and concentrate on them. To put it in other words, they have the gift to decompose a whole into constituent elements that leaves them with the opportunity to focus on, transform, and generally manipulate the constituents independently of one another. The downside to these qualities is that these people are likely to be aloof and not gregarious, which results in a less effective relationship with others (Skehan, 1998). FD individuals, on the other hand, see the world as an unanalyzed whole and do not tend to attend any part of it selectively. They are deemed to be person-oriented, interested in people and sensitive to them. Brown (1987, P. 85) defines FI as "your ability to perceive a particular, relevant item or factor in a field of distracting items".

People termed FI, are more analytic, and learn effectively when confronted with a body of material to be assimilated. Brown (1987, P. 85) points out that "field may be perceptual or it may be abstract in referring to a set of thoughts, ideas, or feelings from which your task is to perceive specific relevant subsets". The FI person tends to articulate figures as discrete items from their background and to easily differentiate objects from embedding contexts. FI (or analytical) individuals have more facility with tasks requiring differentiation and analysis. Brown (1987, P. 85) defines FD style as: "the tendency to be dependent on the total field such that the parts embedded within the field are not easily perceived, though that total field is perceived more

clearly as a unified whole". FD people tend to experience events globally in an undifferentiated fashion. These people tend to identify with a group, exhibiting a social orientation in which they are more perceptive and sensitive to social characteristics such as names and faces than are FI persons, but they are also more susceptible to external influence and more markedly affected by isolation from other people.

At a personal level, as Dornyei and Skehan (2003), Skehan (1998), and many others put it, FI learners are aloof and would prefer to find solutions to problems for themselves. These learners are not sociable and prefer to learn individually. FD learners, in contrast, are sociable and work well in groups. They are inclined to interact more and seek out more contact with other users of the second language. According to Davis (2006) field dependent individuals are typically extrovert, extrinsically motivated, and influenced by peer groups and authority figures. Field independent individuals typically possess less effective social skills, are typically introvert, intrinsically motivated, prefer competition, choice of activities, and ability to design studies and work structure.

#### d) Relational Style

Onwu and Asuzu (1986) defined relational style as a mode to associate objects or events on the basis of features establishing a relational link between them.

#### e) Inferential style

Onwu and Asuzu (1989) defined inferential style as the tendency to associate objects or events on the basis of super ordinate features which are not directly discernible but are inferred. It is an imaginative tendency. For example, a car and a boat are similar because both are means of transportation.

## 2.2.4 Cognitive processes

Jonassen and Grabowski (1993) propose a transition from cognitive abilities to learning styles (See, Figure 1.0). Cognitive abilities cover the content and refers to the level of cognitive activity whereas styles indicate the manner and form of learning. According to the authors, abilities are stated in terms of maximal performance; therefore, they are unipolar (i.e., less ability..... more ability) and value directional measures (having more is better than having less), whereas styles are bipolar (visual....verbal) and value differentiated (neither pole is necessarily better). Jonassen and Grabowski (1993) conclude that abilities enable learners to perform task whereas styles control the ways in which tasks are performed.

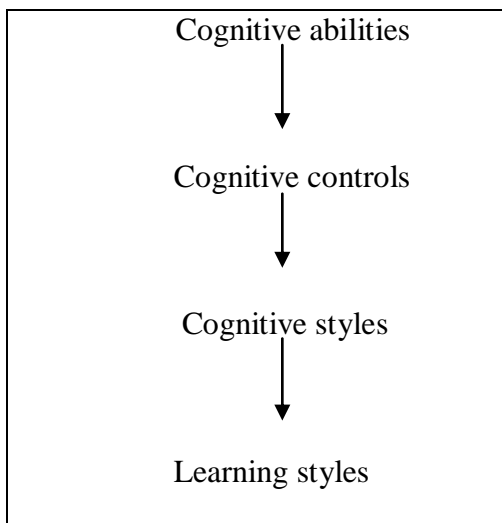


Figure 1.0: The relational transition of cognitive processes

### **2.2.5 Cognitive styles (Field Dependency) and Academic Achievement**

Cognitive style has been reported to be one of the significant factors that may impact students' achievement on various school subjects (see, Murphy, Casey, Day, & Young, 1997; Cakan, 2000). In a research study, Dwyer and Moore (1995) investigated the effect of cognitive style on achievement with 179 students who enrolled in an introductory education course at two universities in the United States. They found the field independent learners to be superior to field dependent learners on tests measuring different educational objectives. The researchers concluded that cognitive style had a significant association with students' academic achievement. In another study, Murphy, Casey, Day, & Young (1997) sought to determine the relationship between academic achievement and cognitive style of 63 undergraduate Canadian students in information management program. They found that field independent students performed better than field dependent subjects on one of the technical courses.

In experiments that attempt to flesh out differences in performance between field independent (FI) and field dependent (FD) individuals, it has been found that FI learners, when faced with a limited amount of unambiguous task relevant information, will frequently outperform their FD learner peers (Rollock, 1992). In fact, Davis and Cochran (1989) indicate that research generally shows that field independent students, reflect higher levels of achievement than field dependent students do. Muhammad (2001) pointed that students with field- independent cognitive style have higher academic achievement than students with field- dependent cognitive style.

There is also evidence connecting cognitive style to choices and performance within a given domain. Thus, first-year graduate students entering a program in clinical psychology were significantly more field dependent than 'students in the same school entering an experimental

psychology program- -the "thing" and "abstractions" end of the spectrum (Nagle, 1967). Another study (Blatt & Quinlan, personal communication)-found that high-achieving students in psychiatric nursing were significantly more field dependent than high-achieving students in surgical nursing, who tended to be field independent.

The processing mode and other personal characteristics related to cognitive style seem to be conditioning the interaction between the subjects' performance as learners and educational contextual factors, predictably conforming stable and consistent patterns of behavior associated with teaching-learning situation; they could be affective, cognitive and/or meta-cognitive types of patterns. Thus, we should pose the mediator or moderator role that motivational and volitional control strategies and planning strategies could exert on the influence of cognitive style on academic achievement.

An explanatory model of academic achievement was suggested, taking into account cognitive style and learning strategies, and it was confirmed through *path analysis*, supporting that planning strategies could act as a moderating variable in the influence of cognitive style on academic achievement.

Planning is a meta-cognitive process present in self-regulated learning, which includes setting objectives and planning strategies, contents and contextual resources to be used during the academic task (Pintrich, 2002; Zimmerman, 2002). In a study by Liu and Reed (1994) with a university sample, field-independent students were found to impose a personal sequence on a computer course they had to follow, while their field dependent classmates followed the sequence established by the course. These results are consistent with those obtained in the present study, which has revealed that field independence favors the use of planning strategies.

In addition, the differential tendency to plan own learning, seems to reflect in academic achievement, acting as moderator on the influence of cognitive style on academic success or failure. It has been suggested that confidence in the internal references which characterizes field-independent subjects is more in harmony with meta-cognitive functioning: this could lead to an earlier and more efficient development of metacognitive abilities (Boutin & Chinien, 1992; Davis & Cochran, 1990; Liu & Reed, 1994). If this is the case and considering the results of this study, specific training in planning strategies from primary education levels should be regarded as an immediate step in attending learning diversity due to cognitive style in academic contexts.

### **2.2.6 Cognitive styles and gender**

Sternberg (1995) addresses that thinking styles of women and men are different because specific styles may be encouraged and punished and men's scores in comparison with women's are higher in legislative and internal thinking styles and it is lower in judging style. Zhang and Sternberg (2002) study thinking styles of Hong Kong and Chinese students. Difference between females and males is significant in thinking style inventory so that male and female students are different in legislative, judicative, general, free and internal thinking styles, and in all cases males' scores are higher than females'.

In a study by Witkin et al (1971) on Field dependence and field independence, he noted that males tend to represent field independence as their cognitive style.

Arrington (1987), Nabulsi (1995), Ellen (2001) and Enooz (2003) pointed that males tend to field-independent cognitive style, while females tend to field-dependent cognitive style. Cherkaoui (1985), Smadi (1992), pointed that no differences between males and females in field-dependent and field- independent cognitive style.



### **2.2.7 Cognitive Styles and Instructional Methods**

A limited amount of research has been conducted in an effort to determine the potential existence of relationships between individual differences in Cognitive Style and various instructional methods. Grieve and Davis (Terrance D.Grieve and J. Kent Davis, 1971) analysed interactions between extreme Cognitive Style levels and two methods of instruction, discovery and expository. They reported that extreme global males taught by an expository method experienced significant difficulty on criteria measures. Additional data collected by Grieve and Davis, along with similar studies by Nelson (Barbara A. Nelson 1972, *Dissertation Abstracts*1973) and Thornell (John G. Thornell, 1974), using a median split of the sample to classify the subjects' Cognitive Styles, failed to find interaction effects between instructional methods and Cognitive Style.

The sensitivity of the teacher in dealing with individual learner differences in Cognitive Styles in his /her classroom may be of significant influence in facilitating learning. Following the identification of relative individual differences in Cognitive Styles of students in a classroom, the teacher can provide a multiplicity of strategies and techniques to determine which seems to be the most feasible, in terms of class time and effectiveness, for analytic and global children. Grieve and Davis (Terrance D.Grieve and J. Kent Davis, 1971) suggested the inappropriateness of the expository instructional method in comparison with the discovery method, for certain global subjects. The teacher can examine the efficacy of various methods of discovery teaching with global children to see if academic results coincide with those of Grieve and Davis. The action research may yield additional information regarding strategies that are particularly effective with children of different Cognitive Styles. Also the teacher must recognize the body of

research suggesting the advantage of being analytic, rather than global in performance of many different learning tasks in the classroom.

The results of the aforementioned studies suggest that an analytic style is preferable to a global one, in terms of the particular learning task mentioned. Therefore, the teacher may need to put forth additional effort with the global learner. Individual curriculum counseling and planning, tutoring, and the intensified use of concrete materials are only a few of the components in instruction that may serve as valuable forms of compensatory education for the global child.

It seems reasonable to expect that we would find a heavy concentration of more field-independent teachers in the mathematics-science domain, and a wider range of individual differences in cognitive style in the social-sciences-humanities domain.

Relatively field-dependent teachers have been found to prefer a discussion or discovery method of teaching, rather than a lecturing method which is preferred by relatively field-independent teachers (Wu, 1967).

Finally, teachers can determine the degree of instructional guidance required by analytic and global children to achieve specified educational objectives. Assuming that certain children in the classroom can function effectively on an independent study basis, this would provide the teacher with information regarding the effective utilization of released time. Thus, the teacher would be able to devote additional time to the recommended compensatory instructional tasks with the global child.

True individualization to instruction should be a multidimensional complex accommodating as many learner traits as possible. The literature and research on Cognitive Style

suggest considerable variability in the information processing modes of different individuals. These differences in Cognitive Styles may be significant factors in determining the type of individualized instructional program most beneficial to various students.

## **2.3 The Theories of Cognitive Styles**

### **2.3.1 The Brain Theory**

Some writers have linked cognitive style to hemispheric specialization. Kane and Kane (1979) suggested the roles played by each hemisphere in a variety of different modes. For thinking, the right brain is described as deductive, divergent, intuitive, holistic, relating to concepts, simultaneity and geometry, while the left brain is described as inductive, convergent, segmented, logical and algebraic. Wheatley (1977; Wheatley et al., 1978) linked problem solving styles with left and right brain specializations. He described the right brain as all-at-once and gestalt and the left as one-at-a-time and serial. Wheatley also concluded that a good problem solver achieves a smooth integration of the two modes of thinking.

### **2.3.2 Anderson's Theory of Cognitive development.**

Anderson proposes that human cognitive architectures will have adapted optimally to the problems posed in their environment. Therefore, discovery in the optimal solution to the problem posed by the environment, independent of the architecture is equivalent to discovering the mechanism used by the architecture. A relational analysis, as it is called, takes in to account the available information in the environment, the goals of the agent and some basic assumptions. Wright and others (Betty A. Wright and others, 1971) describe Cognitive Style as an umbrella

term covering the many ways an individual perceives, organizes, classifies and / or labels various environmental factors.

### **2.3.3 Reflection – Impulsivity theory**

Reflection – Impulsivity Also called conceptual tempo, studies in reflectivity – impulsivity were first introduced by Kagan in 1965 and are the easiest of the theories to measure. Kagan administered the Matching Familiar Figures Test to children and measured the time it took them to make decisions. One group of children made decisions after briefly looking at the figures, thus they were cognitively impulsive, while the other group carefully deliberated the choices before coming to a decision, thus they were cognitively reflective. Kagan tested repeatedly to find that conceptual tempo is stable, that is test subjects will repeatedly test as either impulsive or reflective. There is some hesitation as to whether this applies in high-uncertainty situations only (Sternberger & Grigorenko, 1997). It is also important to note that impulsivity, as a cognitive style is not the same as having an impulsive personality (Sternberger & Grigorenko, 1997).

### **2.3.4 Witkin’s theory of field dependence – independence**

Field Dependence – Independence A measure of field dependence is one of the most researched cognitive styles to date (Witkin & Goodenough, 1981) and was initially proposed by Witkin in the 1950’s and 1960’s and with educational implications by Witkin, Moore, Goodenough, and Cox in 1977. Original testing was done using the Body Adjustment Test and the Rod and Frame Test. In these tests subjects were asked to determine their alignment/misalignment with true vertical given internal and external stimuli that may differ

(experimental set-up described in-depth by Wikin et al., 1977). It was found that one group of subjects determined their alignment as vertical based solely on the visual cues in the room. Witkin states that, It may be astounding that someone can be tilted as much as 35 degrees, and, if in that position he is aligned to with the room, tilted at the same angle, he will report that he is perfectly straight, that ‘this is the way I eat my dinner,’ ‘this is the way I sit in class’ (1977, 5). These subjects were field dependent, that is they were unable to determine their vertical alignment because of a discordant visual field while other subjects displayed field independence and were able to perceive their alignment as separate from the visual surroundings. Cognitive Styles, 5 Similarly, the Embedded-Figures Test determines a subject’s field dependence/independence based on the time they take to find a simple figure in a more complex visual field (see Witkin et al., 1977 for examples). Subjects who were field dependent spent more time finding the figure while field independent subjects found the figure quickly. Most people fell on a continuum between being completely field dependent or field independent. The importance of this measure of cognitive style to problem solving soon followed. According to Witkin, The individual, who, in perception, cannot keep an item separate from the surrounding field – in other words, who is relatively field dependent – is likely to have difficulty with that class of problems...where the solution depends on taking some critical element out of the context in which it is presented and restructuring the problem material so that the item is now used in a different context (1977, 8). The remaining portions of Witkin’s paper discuss the interaction between teachers and students and their field dependence/independence. He found that field dependent students prefer to work in groups, and require extrinsic motivation and more structured reinforcement from teachers. Conversely, field independent students prefer individual work and tend to be intrinsically motivated. Witkin’s theory of field dependence – independence

does have some detractors. Among them McKenna states that field dependence is not a cognitive style at all but a measure of ability or intelligence. He found significant correlations between scores on the Embedded Figures Test and standard intelligence test scores (1983). Others support this view of field dependence as an aspect of intelligence (Sternberger & Grigorenko, 1997; Ridding & Cheema, 1991). Witkin also found a slight but persistent difference among the sexes (namely, that females tended towards field dependence).

### **2.3.5 Pask's theory (Holistic – Serialistic theory)**

The holistic – serialistic cognitive style was researched by Pask in the early 1970's. There are two controversies related to Pask's theory. First is that Pask himself defines his theory as cognitive strategies rather than styles. This implies something that can be chosen by the person, however, Pask's further research concluded that holist students that were given a 'serialist-oriented' assignment performed poorly and vice versa. Thus, if these strategies were simply the students' preferences why would they prefer to perform poorly (Roberts & Newton, 2000)? The second detraction from Pask's theory is that, according to Ridding and Cheema, Pask used only a small group of students all 15 years of age or older and the experiment has not been repeated (1991). By contrasts, serialists, or operation learners, proceeded with one hypothesis at a time and did not move on until that was tested. Serialist tended not to think about a larger global view of the problem (Pask, 1976). Unlike Witkin's theory of field dependence, there is little or no statistical correlation between holistic – serialistic subjects and scores on standardized intelligence tests (Ridding & Cheema, 1991). In field dependence one trait (field independence) is generally always associated with higher achievement. Holistic and serialistic personalities are just as likely to achieve or fail regardless of style. Holists, who tend to easily conceptualize the global view of a problem and acquire additional knowledge beyond that related to the problem

can become globetrotters, e.g. they lose site of the original purpose and make incorrect analogies. Likewise, serialists, who tend to be very analytical and logical in their understanding of the specific goals of the problem can develop improvidence where they are unable to identify the overall concept of a problem. Some learners seem to be able to switch between the two styles more readily and are called versatile learners. Several studies have been conducted regarding brain hemisphere behavior and its effect on perception and information assimilation.

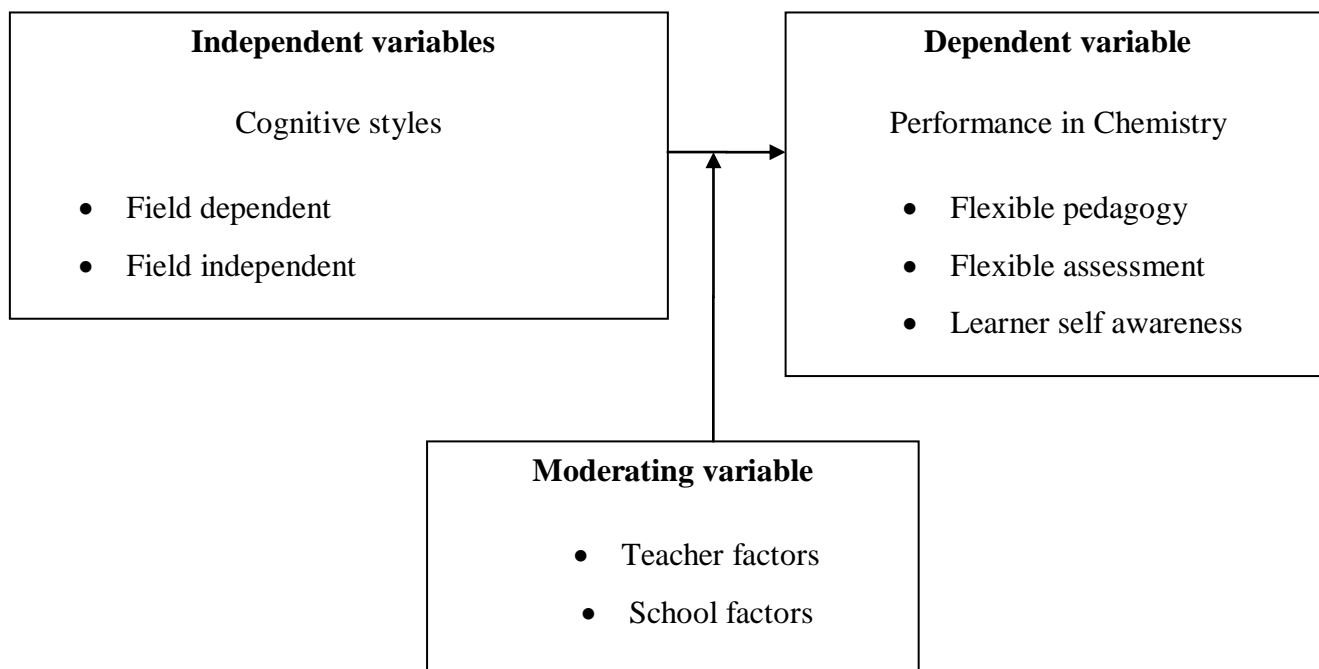
### **2.3.6 Theory of Virtual Environments**

The development of the World Wide Web has significantly changed the way that information is presented and retrieved in information systems (Kim & Allen, 2002). Virtual environments refer to information spaces that exist beyond the traditional print world – the World Wide Web, on-line databases, and even CD-ROM products. As Ford points out, “virtual environments allow greater flexibility of navigation than do their physical counterparts (Ford, 2000, 543).” Specifically there is no longer one route to a particular information source but a variety of ways that users can access the same piece of information and a greater capacity for the user to make autonomous decisions in searching. Research on how users adapt to this new environment is important in building more intelligent information retrieval systems with an understanding of human-computer interaction principles (Saracevic & Kantor, 1991). One of the characteristics that effect user interaction with systems is their cognitive style.

### **2.4 Theoretical framework/ Conceptual framework.**

This study is based on Anderson’s Theory of Cognitive development. Anderson proposes that human cognitive architectures will have adapted optimally to the problems posed in their environment. Therefore, discovery in the optimal solution to the problem posed by the environment, independent of the architecture is equivalent to discovering the mechanism used by

the architecture. A relational analysis, as it is called, takes in to account the available information in the environment, the goals of the agent and some basic assumptions. Wright and others (Betty A. Wright and others, 1971) describe Cognitive Style as an umbrella term covering the many ways an individual perceives, organizes, classifies and / or labels various environmental factors. Figure 2.1 shows the interplay between various variables which brings about the learning environment from which performance in chemistry emerges as a desired outcome.



**Figure 1.1: Conceptual Framework**



This study therefore seeks to find out how student factors, and specifically cognitive styles, affect their academic achievement in chemistry. This is because, since individuals adapt differently to problems posed in their environment, in this case the academic environment, their performance in different subjects would also differ. It is hoped that, if these different cognitive styles are identified, learners can be guided on the best way to approach their studies and teachers can adopt teaching styles which help the learner to achieve optimally in the different subjects. Teachers can determine the degree of instructional guidance required by children with different cognitive styles to achieve specified educational objectives. True individualization to instruction should be a multidimensional complex accommodating as many learner traits as possible.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Research design**

This study employed a Quantitative study applying descriptive survey design. The study aimed at collecting information from respondents on their cognitive styles and their influence on achievement in chemistry. This design was chosen because of its ability to obtain quantitative data with regard to the existing cognitive styles and how they influence on achievement in chemistry. The tool that was used was a questionnaire containing two sections which were: Cognitive Style Test and Chemistry Achievement Test which was administered to the selected 200 form three (3) students taking chemistry. The data collected was subjected to data analysis using statistical package for social sciences (SPSS). Quantitative data was analyzed using descriptive statistics.

#### **3.2 Population and Sample size**

##### **3.2.1 Population**

The population from which the sample was drawn comprised the public schools in Mwingi north constituency in Kitui county. Public schools were selected for this study as a result of the uniformity in the curriculum offered and that the syllabus used in teaching is the same for all such schools. The study involved form three students taking chemistry. Mwingi north constituency comprises three sub-counties, namely; Kyuso, Tseikuru and Mumoni. The total number of public schools is 47 schools. There were two extra-county schools, one girls' school and one boys' school, 12 county schools and 33 sub-county schools. The total enrolment in all the schools is about 8000. Respondents were form three boys and girls from the selected schools.

### **3.2.2 Population sampling**

Schools were selected using stratified and systematic random sampling techniques to come up with a representative sample. A total of 200 students were selected: 100 girls and 100 boys. Half of the respondents, that is 100 students, 50 girls and 50 boys was sampled from high achieving schools while the other half, that is 100 students, 50 girls and 50 boys was sampled from low achieving schools.

### **3.3 Instrument for data collection**

The instrument used in this study was the Chemistry Students' Questionnaire (CSQ), containing three sections, that is: personal information, performance in chemistry and field independence/field dependence questionnaire which was administered to the selected 200 form three (3) students taking chemistry (Appendix I). This instrument was used to gather information from the sample schools which will basically be the learners' cognitive style(s) and performance in chemistry. The questionnaire contained 9 statements for each of the two cognitive styles (Field Dependent or Field independence) which were used to measure the participant's preference for each cognitive style dimension. The highest score in the field dependence/independence is 27. The highest score between the two dimensions (FD/FI) indicated strength or inclination to that cognitive style. The lowest score is 9, which indicate that the learner is not inclined to either field dependence or field independence cognitive dimensions.

### **3.4 Validity of instruments**

Since the instrument was a published one (see appendix: I), validity issues were assumed.<sup>1</sup>

### **3.5 Preliminary Preparation**

Before administering the instruments; permission from the sample schools' head teachers will be sought. The researcher went ahead and established a working relationship with the chemistry teachers. This was a crucial stage in this study because it is during this time that the researcher obtained teachers' consent to offer the necessary support in the study. This depended on the rapport established and the teachers' confidence the researcher had won. Teachers' consent, teachers' confidence in the researcher and rapport between researcher and the teachers all worked to ensure the success of this study. All through, the researcher assured the school administration, teachers and students that the data collected was not used for any other purposes other than this study and that it would be treated with utmost confidence.

The appropriate time for administration of students' questionnaires was negotiated between the researcher, the school administration and the teachers. The researcher requested to be introduced to the students by a teacher from the school who was not a chemistry teacher during administration of CSQ. The presence of a chemistry teacher in the room was likely to have an effect on the students' responses.

### **3.6 Data analysis procedure and presentation**

A clearer understanding of what an individual learner has learned in specific subjects is reflected in achievement tests (Brown, 1993). Using Statistical Package for Social Sciences

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<sup>1</sup> The study used field independence/dependence questionnaire by Robert Wyss (2002)

(SPSS), the data collected using the instrument was analysed quantitatively. Quantitative data was analysed using descriptive statistics. The mean and standard deviation of students' responses to the questionnaires were calculated. To find out the relationship between students' cognitive style and academic achievement in chemistry, Pearson's product moment correlation was used to evaluate the strength and direction of the two variables. On the other hand, to determine if there is a difference in the type of cognitive style in terms of gender, independent samples t-test was used to determine if a difference exists between the means of the two independent groups (boys and girls) on the dependent variable (academic performance in chemistry).

To find out if there is a relationship between gender and academic performance in chemistry, an independent t-test was used. The results were presented using descriptive statistics which included percentages, means, standard deviations, tables and bar graphs. From the analysis the findings were discussed. Conclusions and relevant recommendations were then made.

## **CHAPTER FOUR**

### **RESEARCH FINDINGS**

#### **4.1 Introduction**

This chapter entails analysis and findings of the study as set in the research objectives and methodology. The study findings are presented on cognitive styles in relation to academic achievement in chemistry.

#### **4.2 Response Rate**

The researcher targeted 47 public schools in Mwingi north constituency in Kitui county. The data collection instruments, questionnaires were sent to 200 students at the schools. Out of the 200 questionnaires sent, only 196 questionnaires were sent back fully completed making a response rate of 98%. This was in line with Mugenda and Mugenda (2003) who suggested that for generalization a response rate of 50% is adequate for analysis and reporting, 60% is good and a response rate of 70% and over is excellent.

The response rate was arrived at through the data collection procedure of using the questionnaires adopted by the researcher; she personally participated in data collection process with assistance of some teachers from the various schools she visited and waited for respondents to complete filling the required information.

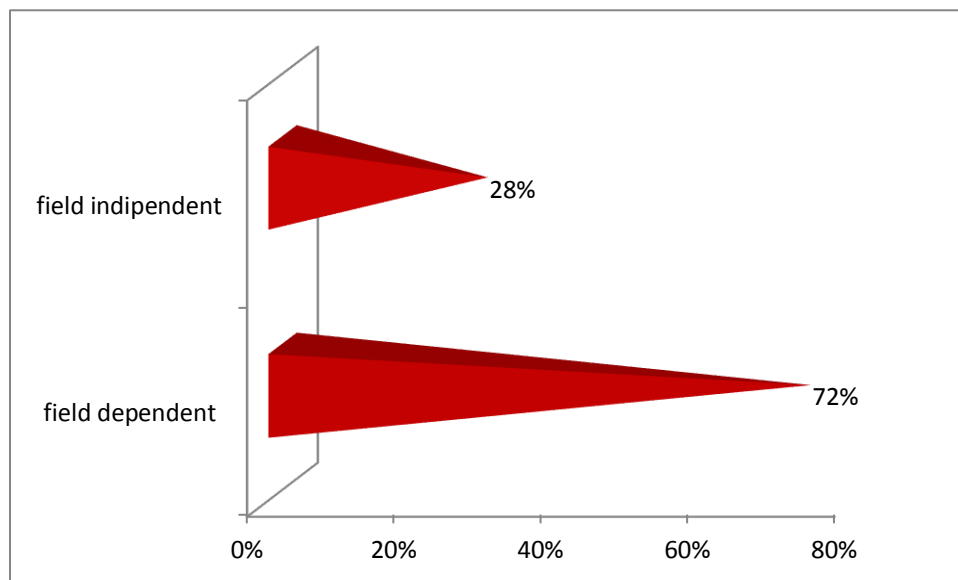
**Table 4.1: Response Rate**

	Frequency	Percent
Responded	196	9%
Not- Responded	4	2%
Total	200	100%

### 4.3 To Determine the Cognitive Styles of Chemistry Students

The study sought to find out the cognitive styles of chemistry students. In relation to this, students were kindly asked to indicate their cognitive styles. The results are shown below

**Figure 4.1: Chemistry Students Cognitive Styles**



The results show that both Field independent and Field dependent cognitive styles are evident among the secondary school students.

From the study findings, the majority of the respondents (72%) indicated that they were field dependent while the rest 28% indicated they were field independent. This indicates that majority of the chemistry students who responded to questionnaires were field dependent.

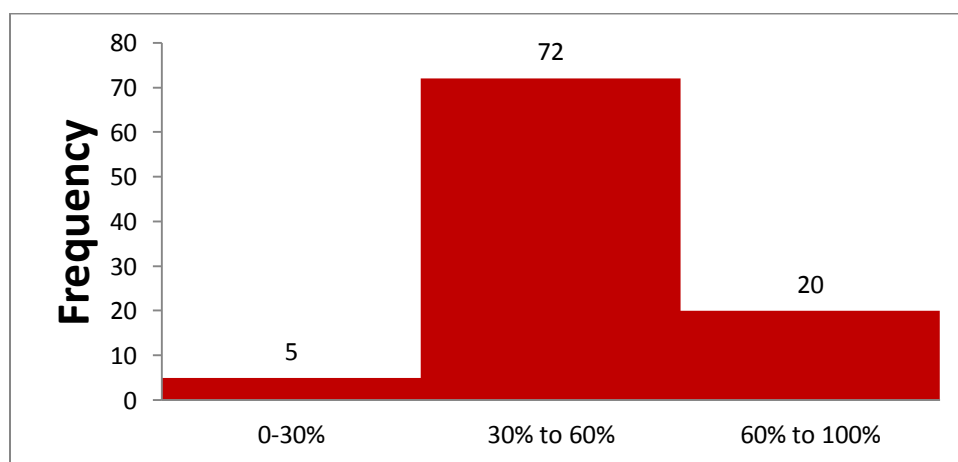
### 4.3.1 Performance in chemistry

The study sought to establish respondent's performance in chemistry. The findings are discussed in subsequent sections

#### 4.3.1.1 Male Academic Performance

The study sought to find out male academic performance. The results are shown in the Figure 4.2

**Figure 4.2: Male Academic Performance**



According to the findings, majority of the respondents (72) scored between 30% and 60% in chemistry, 20 scored between 60% and 100%, while 5 of them scored between 0 and 30%. This

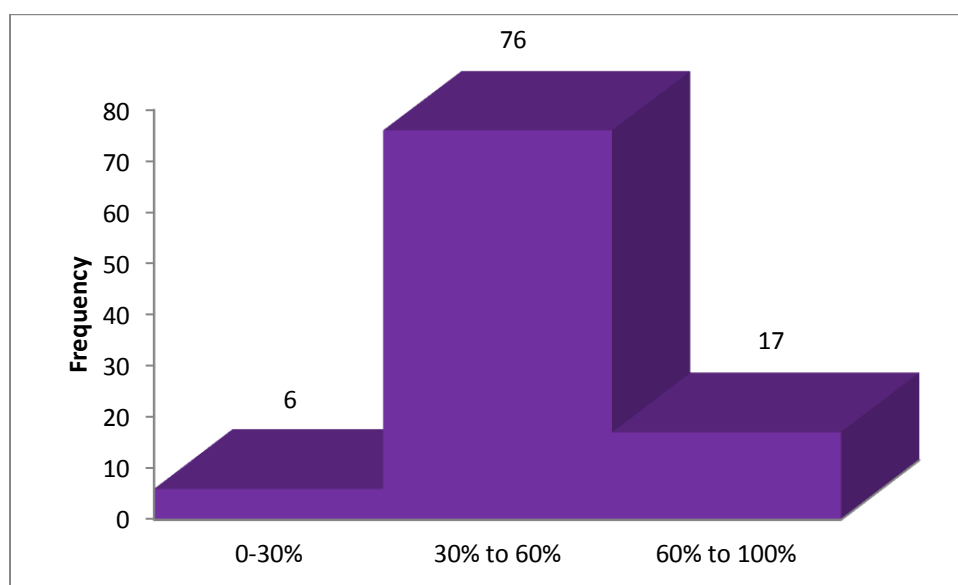


depicts that majority of the males scored between 30% and 60% in chemistry and this indicated that their performance was below average.

#### 4.3.1.2 Female Academic Performance

The study sought to find out respondent's female performance in chemistry. The results are shown in the Figure 4.3

**Figure 4.3: Female Academic Performance**

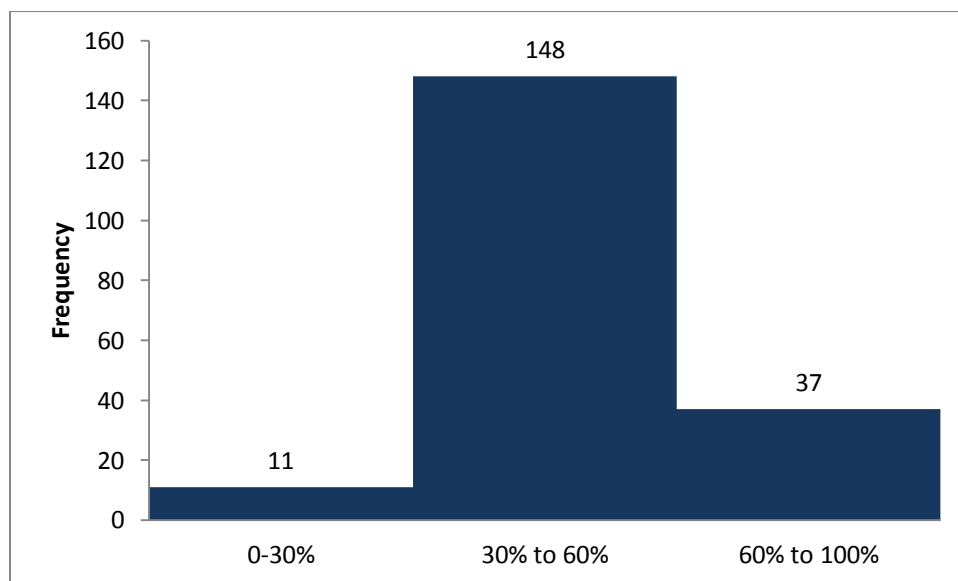


From the study findings, majority of the female respondents (76) scored between 30% and 60% in chemistry, 17 scored between 60% and 100%, while 6 of the female students scored between 0 and 30%. This depicts that majority of the female students scored between 30% to 60% in chemistry and this indicated that their performance was below average.

### 4.3.2 Academic achievements among students generally

The respondents were asked to indicate their average performance in chemistry. The results are as tabulated in the Figure 4.4

Figure 4.4: Academic achievements among students generally



From the study findings, majority of the respondents (148) scored between 30% and 60% in chemistry, 37 scored between 60% and 100%, while 11 scored between 0 and 30%. This depicts that majority of the respondents scored between 30% and 60% in chemistry and thus the performance was below average.

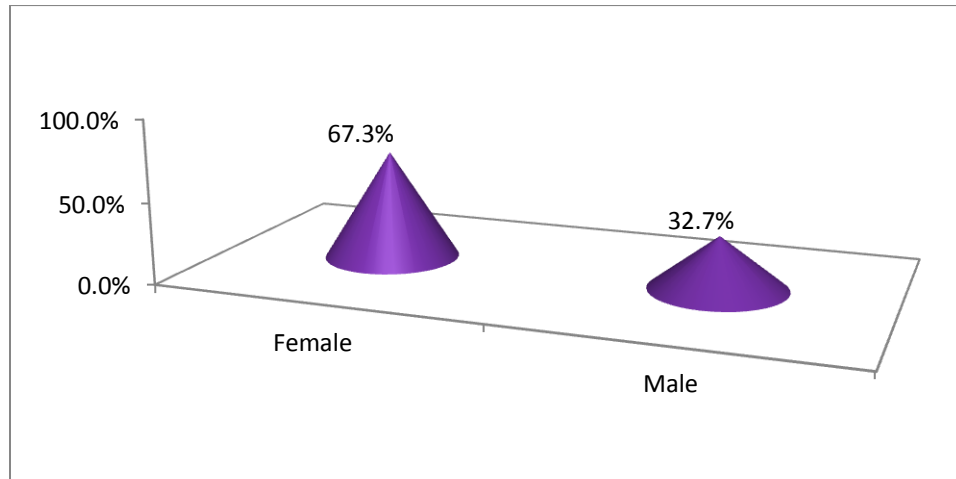
### 4.4 To Determine the Differences in Students' Cognitive Styles among Boys and Girls

The study sought establish whether there are differences in students' cognitive styles among boys and girls. The findings of the study are as shown in subsequent sub-headings.

#### 4.4.1 Differences in field independent cognitive styles among Boys and Girls

The study sought to find out the differences in field independent cognitive styles among Boys and Girls. The results are shown below

Figure 4.1: Differences in field independent cognitive styles among Boys and Girls

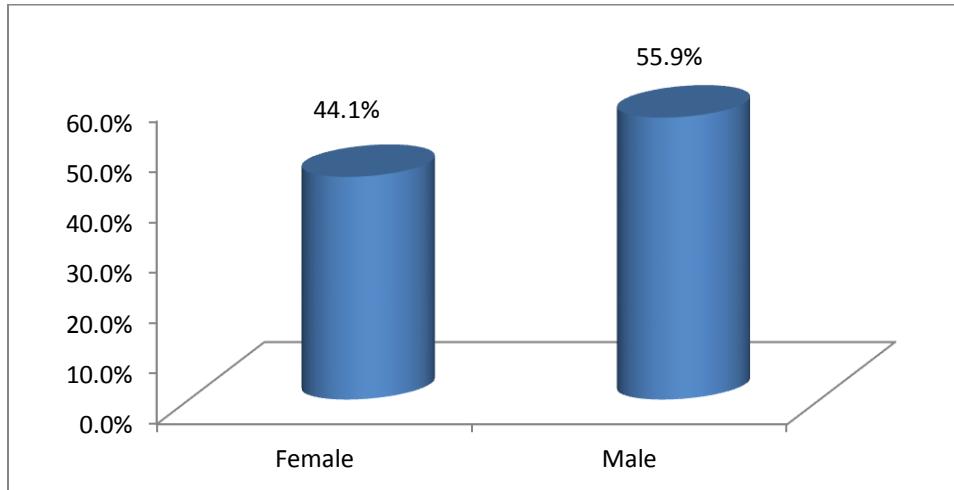


From the study findings, majority of the respondents (67.3%) indicated that they were female while 32.7 % were male. This depicts that majority respondents who were field independent were of the female gender.

#### 4.4.2 Differences in field dependent cognitive styles among Boys and Girls

The study sought to find out the differences in field dependent cognitive styles among Boys and Girls. The results are shown below

Figure 4.2: Differences in field dependent among Boys and Girls



From the study findings, majority of the respondents (55.5%) were male while the remaining (44.1%) were female. This depicts that majority of the respondents who were field dependent were male students.

The analysis also looked at the relationship between type of cognitive style between boys and girls. The following illustrates the statistical relationship between them.

**Table 4.2: Paired Samples Statistics**

		<b>Mean</b>	<b>N</b>	<b>Std. Deviation</b>	<b>Std. Error Mean</b>
Pair 1	Boys cognitive style	3.8196	196	1.11412	.11412

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Boys cognitive style	3.8196	196	1.11412	.11412
	Girls cognitive style	3.6522	196	.98442	.09844

**Table 4.3: Paired Samples Correlations**

		N	Correlation	Sig.
Pair 1	difference in the type of Boys cognitive style and girls cognitive style	196	0.81	.000

The results indicate that the parametric Pearson correlation or 'r' value is significant at .81 and the p-value (Sig) for the correlational coefficient is less than  $p < .05$  and is significant.

**Table 4.4: Paired Samples Test**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	difference in the type of Boys cognitive style and girls cognitive style	1.04	1.11412	.11412	1.85302	1.03923	7.2377	172	0.02

The findings indicate the difference in the type of boys cognitive style ( $M = 3.8$ ,  $SD = 1.1$ ) and girls cognitive style ( $M = 3.6$ ,  $SD = .98$ );  $t(172) = 7.2377$ ,  $p < .05$  and is significant. Therefore there is a significant difference in the type of cognitive style between boys and girls. Further with a 95% confidence interval from 1.85302 to 1.03923; the t-test statistic was 7.2377 with 196 degrees of freedom and an associated P value = 0.00.

#### 4.5 To Find out the Relationship between the Students' Cognitive Styles and Academic Achievement

The study sought to determine the relationship between the students' cognitive styles and academic achievement in chemistry

**Table 4.5: Relationship between the Students' Cognitive Styles and Academic Achievement**

	N	Minimum	Maximum	Mean	Std. Deviation
Field independent	55	25.00	90.00	55.6909	14.11969
Field dependent	141	20.00	77.00	48.6099	12.06709
Total	196				

From the study findings, field independent learners scored a mean of 55.6909% in chemistry, while field dependent learners scored a mean of 48.6099%. This depicts that there is a relationship between students' cognitive styles and their academic achievement. This indicated that field independent learners performed better than field dependent learners in chemistry.

The analysis looked at the relationship between cognitive styles and students' academic achievement in Chemistry. The following illustrates the statistical relationship between them.

**Table 4.6: Paired Samples Statistics**

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Cognitive styles	3.7922	196	1.66411	.66411

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Cognitive styles	3.7922	196	1.66411	.66411
	Academic achievement in Chemistry	2.9115	196	.74456	.07445

**Table 4.7: Paired Samples Correlations**

		N	Correlation	Sig.
Pair 1	Cognitive styles & academic achievement in Chemistry	196	0.79	0

The results indicate that the parametric Pearson correlation or 'r' value is significant at .79 and the p-value (Sig) for the correlational coefficient is less than  $p < .05$  and is significant. This depicts that there is a relationship between students' cognitive styles and their academic achievement.



**Table 4.8: Paired Samples Test**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Cognitive styles & academic achievement in Chemistry	1.44	1.66411	.66411	1.06485	0.12088	1.551	172	.017

There is a significant relationship between cognitive styles & academic achievement in Chemistry ( $M = 3.79$ ;  $M = 2.91$ ). However their respective standard deviations, 1.66 and .74 are very far apart statistically. Further the  $t(172) = 1.551$ ,  $p < .05$ . Further with a 95% confidence interval from .18075 to 1.97925; the t-test statistic was 1.551 with 196 degrees of freedom and an associated P value = .017.

#### 4.7 Summary

The study revealed that majority of the chemistry students were field dependent and that most of them were males while most of the field independent student's were females. The study also established that field independent students performed better than field dependent. The study established that cognitive styles have significant influence on students' academic achievement in chemistry. The study also established that there is significant difference in the type of cognitive

style between boys and girls and that there is a relationship between students' cognitive styles and their academic achievement.

## **CHAPTER FIVE:**

### **DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter discusses the findings on cognitive styles in relation to academic achievement in chemistry. The discussion of the findings, conclusions and recommendations are drawn there to. The chapter is therefore structured into discussion of the findings, conclusions and recommendations.

#### **5.2 Discussion**

##### **5.2.1 Chemistry Students Cognitive Styles**

The study revealed that both Field independent and Field dependent cognitive styles are evident among the secondary school students. The study also revealed that majority of the chemistry students who responded to the questionnaires were field dependent. More male students were found to be field dependent while more female students were field independent. The results also revealed that field independent individuals scored higher than field dependent individuals. The study concluded that cognitive styles have significant influence on students' academic achievement in chemistry and that there is significant difference in the type of cognitive style between boys and girls.

### **5.2.2 Differences in Students' Cognitive Styles among Boys and Girls**

The study also revealed that majority of the chemistry students were field dependent. Majority of the respondents who were field dependent were male students while majority of the respondents who were field independent were of the female gender.

### **5.2.3 Relationship between the Students' Cognitive Styles and Academic Achievement**

The study established that cognitive styles have significant influence on students' academic achievement in chemistry. Cognitive style has been reported to be one of the significant factors that may impact students' achievement on various school subjects (see, Murphy, Casey, Day, & Young, 1997; Cakan, 2000). The study also established that field independent students performed better in chemistry than field dependent students. This is in line with another study by Murphy. In that study, Murphy, Casey, Day, & Young (1997) sought to determine the relationship between academic achievement and cognitive style of 63 undergraduate Canadian students in information management program. They found that field independent students performed better than field dependent subjects on one of the technical courses. In line with these findings, Dwyer and Moore (1995) investigated the effect of cognitive style on achievement with 179 students who enrolled in an introductory education course at two universities in the United States. They found the field independent learners to be superior to field dependent learners on tests measuring different educational objectives.

Similarly Sternberg (1995) addresses that thinking styles of women and men are different because specific styles may be encouraged and punished and men's scores in comparison with women's are higher in legislative and internal thinking styles and lower in judging style. Zhang

and Sternberg (2002) study thinking styles of Hong Kong and Chinese students. Difference between females and males is significant in thinking style inventory so that male and female students are different in legislative, judicative, general, free and internal thinking styles, and in all cases males' scores are higher than females'.

The researcher concluded that cognitive style had a significant association with students' academic achievement.

### **5.3 Conclusion**

The study concluded that both Field independent and Field dependent cognitive styles are evident among the secondary school students. The results also show that more male students were found to be field dependent while more female students were field independent. The study also revealed that field independent individuals scored higher in chemistry than field dependent individuals. According to the research results the study show that cognitive styles could have significant influence on students' academic achievement in chemistry and that there could be a difference in the type of cognitive style between boys and girls. Depending on the cognitive style one has, this could have an influence on academic achievement in a particular discipline.

### **5.5 Recommendations**

Based on the findings of this research, the following recommendations were made:

- Teachers should identify strong style patterns in their classes and utilize relevant approaches to accommodate individual cognitive style preferences.

- Teachers and education stakeholders should help learners to enhance their learning power by being aware of their cognitive styles. By working on those cognitive style areas, learners can be provided with avenues to foster their intellectual growth.
- Workshops should be organized by curriculum designers and education stakeholders for all science teachers to emphasize on the use of cognitive styles as a means of achieving better academic performance in chemistry.
- To meet differences in students' cognitive styles among boys and girls, teachers should understand students' cognitive styles. They should ensure that lessons include different approaches to explaining new concepts and provide options for independent classroom work.
- Curriculum designers and classroom teachers should understand cognitive style preferences in order to utilize relevant approaches to enhance meaningful learning.

### **5.6 Recommendation for Further Study**

This study investigated on influence of cognitive styles in relation to academic achievement in chemistry. The study suggests that further research be done on the school based factors influencing learner performance in high school science subjects with a focus to more counties in order to identify the consistency of the results. Further, cognitive styles in relation to academic achievement in humanities and technical subjects can be investigated and comparisons made in order to have a broader perspective of cognitive styles in relation to academic achievement. There is need for further research with a large sample and various types of learners as well as various disciplines to make a conclusive conclusion on cognitive styles and academic performance.

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## APPENDICES

### Appendix I: Chemistry Students Questionnaire (CSQ)

Dear student,

You have been selected to be a participant in this study. You are requested to respond as indicated. Please respond to all items as sincerely as possible.

#### Section A: Personal Information.

1. Gender: Male (  ) Female (  ) (Tick the appropriate response (√))
2. How old are you? ----- years
3. Name of your school----- secondary school
4. Is chemistry compulsory in your school? Yes (  ) No (  )

#### Section B: Performance in chemistry.

Please give the following information concerning performance in chemistry in form three. Write down your percentage marks of two of the latest tests you have done in form three.

Test	Percentage mark
1.	
2.	
Total	
Average	

#### Section C: Cognitive style Test

Please turn to the next page and follow the instructions given in the field independence/dependence questionnaire by Robert Wyss (2002).

## FIELD INDEPENDENCE/DEPENDENCE QUESTIONNAIRE

By Robert Wyss (2002)

Instructions to learners:

Check one box in each item that best describes you. Boxes A and E would indicate that the statement is very much like you. Boxes B and D would indicate that the sentence is more or less like you. Box C would indicate that you have no particular inclination one way or the other.

	Statement	A	B	C	D	E	Statement
1	I have no problem concentrating amid noise and confusion while studying.	3	2	1	2	3	I need a quiet environment in order to concentrate well in my studies.
2	I enjoy analysing subject content and thematic issues personally in order to understand it better	3	2	1	2	3	I find it tedious and boring to analyse the subject content and thematic issues
3	I feel I must understand every word of what I read or hear in every subject in class	3	2	1	2	3	I don't mind reading or listening on the subject teaching without understanding every single word as long as I 'catch' the main idea.
4	I think individual study is the key to effective subject learning.	3	2	1	2	3	I think discussion is the key to effective subject learning.
5	I prefer working alone to working with other people.	3	2	1	2	3	I really enjoy working with other people in pairs or groups.
6	Receiving feedback from other people really doesn't affect my learning at all.	3	2	1	2	3	I find feedback useful as a means of understanding my problem areas.
7	I usually look for solutions to my learning challenges by thinking through and acting on my skills and experiences	3	2	1	2	3	I usually seek to know what other people would handle similar challenges and try out the various ways of solving them
8	I usually pick my books and read even when my classmates are relaxing in the fields	3	2	1	2	3	I can read well when my classmates are settled and focused for individual studies around me
9	I don't like it when other activities interfere with my learning timetable	3	2	1	2	3	I like it when I'm exposed to various activities in between my learning timetable to break the monotony of continuous studying
	TOTAL						
	Field Independent (FI) Score _____						Field Dependent (FD) Score _____

## **Appendix II: Letter of Introduction to the Respondents**

Dear student,

### **RE: THE IMPACT OF COGNITIVE STYLES ON ACADEMIC ACHIEVEMENT IN CHEMISTRY**

I am a post graduate student at the University of Nairobi pursuing a Master of Education degree in Measurement and Evaluation conducting a research on the above topic.

I am kindly requesting you to respond to the questionnaire schedule attached as honestly as possible. The information is required for academic reason only and will be treated with utmost confidentiality. Do not put your name or any other form of identification on the questionnaire.

I look forward to your honest participation.

Thank you for accepting to participate.

### **Appendix III: Letter of Introduction to Schools**

Margaret N. Musya

University of Nairobi

Department of Psychology

Box 30197

Nairobi.

To

The Head teacher

----- Secondary school

Dear sir/madam

RE: PERMISSION TO CONDUCT RESEARCH AT THE SCHOOL

I am a post graduate student at the University of Nairobi pursuing a Master of Education degree in Measurement and Evaluation conducting a research on the topic “Impact of cognitive styles on academic achievement in chemistry”

I am therefore requesting you to allow me to visit your school and collect the required data. The information collected will be treated with utmost confidentiality and will only be used for the purpose of research.

Thank you in advance for co operation.

Yours faithfully

Margaret N. Musya.

University Of Nairobi